Limited data exists for price points related to these groups. The general home users are currently paying $20 to $40 per month for Internet access using dialup modems (up to 56 kbps). Some home business users have ISDN which doubles the bandwidth (112 to 128 kbps) and the price ($40 to $60). Further, during a recent cable modem trial[17], Internet access was first offered free of charge to roughly 280 experimental users. When fees were later imposed (e.g., $40/month), very few users actually dropped out, despite the sudden "sticker shock". A subsequent price-sensitivity analysis showed little benefit (i.e., revenue increase) in lowering the price from $40 to $30/month. This is an indication that demand for Internet access may be relatively inelastic—just as it is for most other telecommunications services. Preliminary results from cable modem introductions elsewhere tend to reinforce this hypothesis. Of course, this result may not hold true for all market segments. Such trials are usually conducted in upscale, computer-literate communities that do not necessarily represent the larger mass market. So, this could apply to telecommuters and online home businesses. But there is at least one well-known counter-example (i.e., the sudden, overwhelming flood of traffic that occurred when AOL shifted to flat-rate pricing) that suggests the opposite: that demand is highly elastic. The final, high-end price point comes from Covad's (a competitive LEC) new ADSL offering of 1.1 mbps access for $100 per month. The price points and some approximate quantities are as follows.

U.S. Residential Online Market Segment	Current Segment Size (Users)	Market Size at Midpoint (Cumul. Users)	Price Point ($ per Month)
1. Telecommuters	4 million	Q1= 2 million	P1= $100
2. Home Businesses	6 million	Q2= 5 million	P2= $40
3. Home Applications	12 million	Q3= 12 million	P3= $20

Revenue Potential of High Speed Access.

Figure 9 illustrates the potential of higher speed access for generating additional revenues. Two extreme pricing strategies are shown:

- For a given (fixed) market penetration, increase the price as line speed goes up.
- For a given (fixed) price, capture more market by offering higher line speed.

The first strategy has a better chance of covering any increased costs of offering the higher-speed service. On the other hand, the second strategy may offer competitive advantages while producing a higher consumer surplus and overall social benefit.

Of course, any combination of these two extremes is possible as well.

[17] "Viacom Modem Trial", SRI International Report, 1996

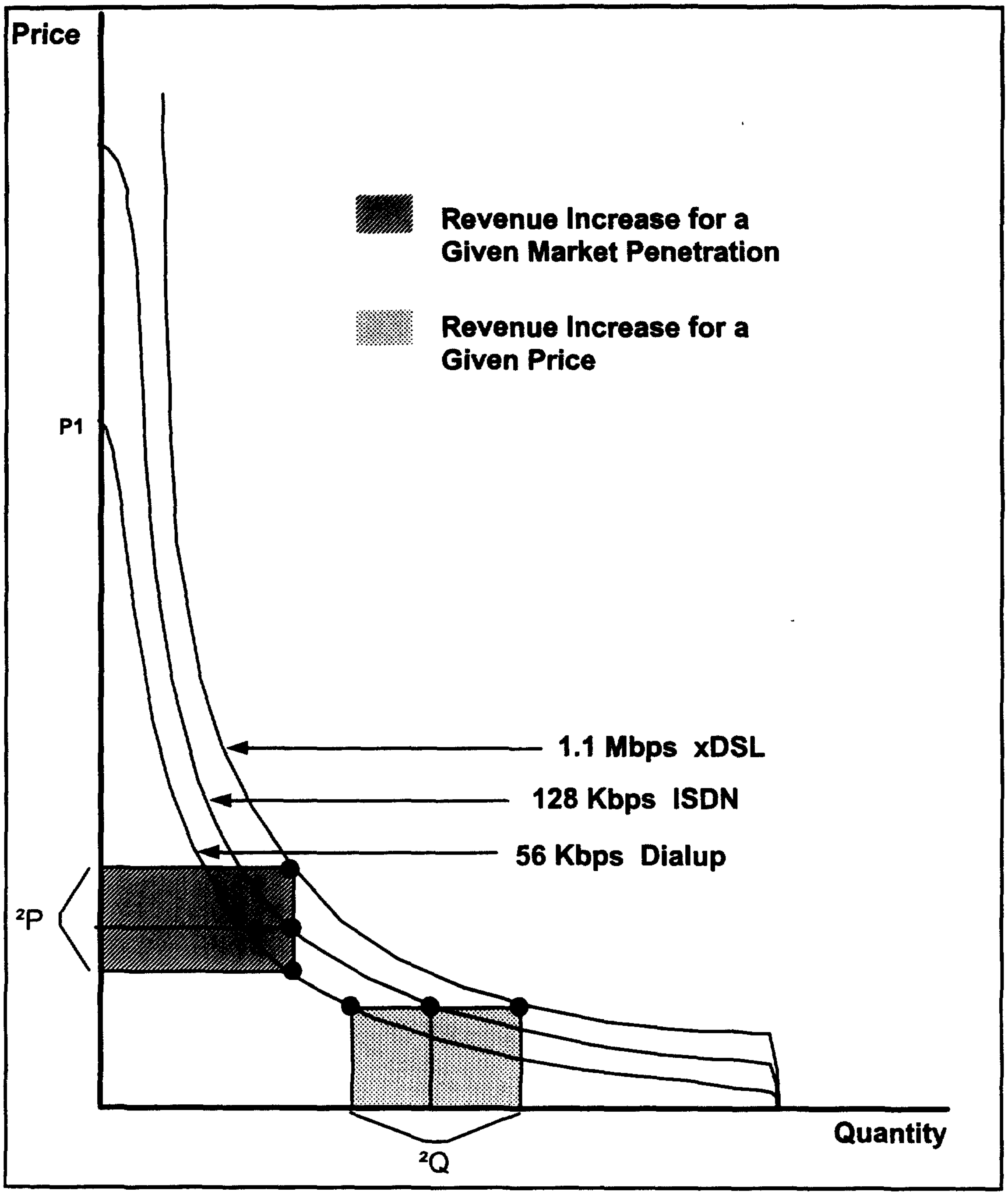

FIGURE 9: REVENUE POTENTIAL

Preliminary Demand Model

To estimate the revenue potential of higher-speed Internet access services, we have developed a preliminary model of demand and willingness to pay. Please note that the resulting model and model outputs presented in this section are necessarily speculative in nature.

Model Assumptions:

To build a preliminary model, a number of assumptions must be made, including the following.

- Access line speed is the sole determinant of perceived service quality. (As discussed above, this is very seldom the case)
- The three market segments are mutually exclusive (the sets of users depicted in Figure 3 do not overlap)
- Willingness to pay does not overlap for the three segments (the overlap shown in Figure 8 can be ignored)
- The access line and the ISP are separate, unbundled services; and the willingness to pay for each is likewise separable.
- The time it would take to attract customers (marketing) or install the necessary infrastructure is not accounted for: That is, the willingness to pay for higher bandwidth access is not going to change over the period of interest (5 years).
- Willingness to pay for an access line for Segment 1 (telecommuters) is assumed to be:
  - $30/month for POTS dialup (up to 56 kbps)
  - $60/month for ISDN (128 kbps)
  - $100/month for access line speeds of 1.1 Mbps or more (xDSL, DirecPC or Cable modems)
- Willingness to pay for an access line for Segment 2 (home businesses) is assumed to be:
  - $25/month for POTS dialup (up to 56 kbps)—i.e., approximately the cost of a business line
  - $40/month for ISDN (128 kbps)
  - $60/month for access line speeds of 1.1 Mbps or more (xDSL, DirecPC or Cable modems)
- Willingness to pay for an access line for Segment 3 (residential; non-business applications) is assumed to be:
  - $20/month for POTS dialup (up to 56 kbps)—i.e., approximately the cost of a residential line

- $30/month for ISDN (128 kbps)
- $45/month for access line speeds of 1.1 Mbps or more (xDSL, DirecPC or Cable modems)

In summary, for modeling purposes, each segment's current willingness to pay is assumed to be:

U.S. Residential Online Market Segment	POTS Dialup (to 56 kbps) $ per mo.	ISDN (128 kbps) $ per mo.	xDSL (1.1 Mbps) $ per mo.
1. Telecommuters	$30	$60	$100
2. Home Businesses	$25	$40	$60
3. Home Applications	$20	$30	$45

TABLE 3: WILLINGNESS TO PAY BY MARKET SEGMENT AND SPEED

Again, the reason for these differences is primarily in the source of the funds that are used to pay for these services. If the home connection is subsidized by the user's employer, willingness to pay is likely to be significantly higher than if it must be expensed by a home business (say, a sole proprietorship). The lowest price point is likely to correspond to the segment that must pay out of the house budget.

Preliminary Results

Based on these assumptions and simplifications, it is possible to generate some preliminary results that can be used as a basis for further investigation and model development.

Revenue Potential of Higher-Speed Access

Table 4, on the next page, summarizes the possible revenue potential of upgrading a particular service level (i.e., access speed) to a higher tier of quality—e.g., from 56 kbps dialup modems to 1.1 Mbps xDSL.

Market Segment Penetration	Cumulative Market Size (Users-Millions)	Upgrade from 56 kbps to 128 kbps	Upgrade from 128 kbps to 1.1 Mbps	Upgrade from 56 kbps to 1.1 Mbps
1: Telecommuters	4	P=$30 **R=$1.44 B**	P=$40 **R=$1.92 B**	P=$70 **R=$3.36 B**
1+2: Home Businesses plus Telecommuters	9	P=$15 **R=$1.62 B**	P=$20 **R=$2.16 B**	P=$35 **R=$3.78 B**
1+2+3: Home Applications plus Home Businesses plus Telecommuters	20	P=$10 **R=$2.40 B**	P=$15 **R=$3.60 B**	P=$25 **R=$6.00 B**

Table 4: REVENUE POTENTIAL OF HIGHER-SPEED ACCESS
(P is change in price-dollars; R is change in revenue-billions of dollars)

In interpreting Table 4 it should be noted that:

- The revenue increases shown are based on a strategy of raising the price while retaining a given market penetration—i.e., the left-hand, cross-hatched rectangle shown in Figure 9 above.
- The three market segments must be penetrated cumulatively in the order shown, since a lower price point will automatically capture those segments that were willing to pay more.
- The price differentials (P in $ per month) are derived directly from Table 2 above. Thus, the per-user annual revenue potential is simply 12 x P.
- The total nationwide annual revenue potential (R) for a given upgrade and segment penetration is calculated as the number of users (column 2) x 12 x P.

Preliminary findings include the following.

- Revenue potential of high-speed upgrades could be substantial, ranging from $1.4 billion to $6.0 billion per year, nationwide. This is based on the approximately 20 million subscribers in 1996. Using the projections shown in Figure 4, projected revenues can be estimated.
- As might be expected, a better upgrade generates more revenue. This is no indication, however, that a better upgrade will generate more profit. (Profitability depends as well on the costs of providing the upgrade).
- Pricing low to penetrate the mass market appears to generate substantially more revenue than pricing high to attract only those niches that are willing to pay the most. However, this result is preliminary: it depends on the price-elasticity of demand (the actual shape of the demand curve) which is not yet well known. And again, absent the cost side, this is not, in itself, an indication of profitability.

Future Outlook

For each market segment (and each potential user within that segment), willingness to pay for higher quality is not likely to change over time. Rather, the definition of "higher quality" will change, as technological innovation and competitive pressures continue to improve service. In particular, with regard to line speed, yesterday's "breakthrough" at 128 kbps will become today's "old news"—a speed that users have come to expect as a matter of course, and that they are no longer willing to pay extra for. However, they will be willing to pay extra for tomorrow's new offering at 1.1 Mbps. Thus, the demand-side will always be willing to pay a certain amount more for better service (higher speed), but, as with the "megahertz wars" in the PC world, the supply-side will be the prime mover for increasing the line-speed ante.

Limitations of this Analysis

As we have noted in several places in this report, insufficient data is available to give precise estimates of price versus quantity of users for high bandwidth Internet access. We have gathered as much quantitative data as possible and used limited scenarios to cope with the areas of uncertainty. As such, the framework that we have set up gives us the best estimates that we can get, and a methodology to refine these estimates with additional surveys if that is desired. Some of the caveats for the data we present here are:

- Most of the reliable data counts number of users and limited data attempts to quantify the amount of time users access the Internet. Users are often projected from number of households and may or may not include non-adults. A more relevant measure for the purposes of this study would be the number of telephone lines and the amount of time spent accessing the Internet. That data is not available. We have attempted to approximate that data by only using numbers of users that access the Internet at least once a week. This results in much more conservative projections of Internet Users growth.
- A large set of Internet users is teens and even pre-teens. Again, very little data is available. Table 2 shows projections for teens (13 to 17 years), and again, is likely on the conservative side. The exact side of this user population and their preferences for Internet services needs to be quantified.
- The VALS Consumer Segmentation System is a powerful method for analyzing consumer demand, but no data was collected for teens or pre-teens. A (weak) assumption was made that teens would follow the VALS segment of their parents. This assumption is weak because it was only used to roughly split teens into segments that would be attracted by interactive services (games) and those that would be attracted by lower cost computing (network computers). If further scenario refinement is done (see next bullet), The VALS segments for teens and pre-teens would also need to be refined.

- This analysis lumped the uncertainty factors in two classes, interactivity and software downloading. A more accurate scenario analysis would use all the factors as independent dimensions (each could occur and not occur). Dynamic software downloading would include: Network Computers (NCs), software components, and Internet radio. Interactivity and its requirement for low latency would include: Internet telephony, real-time games, multi-user interaction, and videoconferencing. This expanded analysis would have 7 dimensions and 128 scenarios. Several of these scenarios would likely not ever occur, but the expanded scenario analysis would include that pruning.
- Projected reliable VALS Segment percentages were only available for the year 2002. The study then made linear projections to the year 2000 and 2004.

Conclusions

We have attempted to give a realistic estimate of the demand for high bandwidth access to Internet Services. There were many constraints on the available quantitative data, but even our conservative estimates show a growing market. There is a great opportunity for the telephone companies to capture this market. Of course there are many issues on the supply side that are not addressed in this report. Those issues will likely be the major determinant of the viability of this market for the telephones companies. The size of the market is attracting a lot of interest by companies that will compete with the telephone companies.

However, a potentially large new service is emerging that could give the telephone companies a unique advantage-The interactive services. While Internet telephony is the first of these, and many technical and regulatory issues need to be resolved, games could be a significant market. The telephone companies know how to provide low-latency two-way communication on a large scale. Combining the strengths of the existing POTS network with a data network could be a large market.

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APPENDIX 1: GLOSSARY

GLOSSARY

Client—A program used to extract information from a server.

Domain Name—Computers on the Internet can have domain names that are mapped onto the computer's formal numeric IP address. Domain names allow you to reference Internet sites without having to know the numerical address

ESP—Enhanced Service Provider

Host—usually meant as a synonym for either "computer" or "IP address", which often doesn't matter,. as there is typically one IP address per computer. Hosts and hostnames are distinctly different. Usually a "host"" means an individual computer or IP address, but there are often multiple hostnames per host.

Hostname—a name which can be resolved (using a name server) into an IP Address. All direct communication between computers on the Internet uses these IP addresses. Human beings, however, prefer more mnemonic names like "www.mit.edu". This is called a "hostname". More rigorously, "www" is the hostname and "mit.edu" is the domain name within the host: "www.mit.edu" is the Fully Qualified Domain Name (FQDN).

Internet—essentially a large number of interconnected computers, or "hosts". The point of connection within each computer is called a network interface—i.e., a modem, an ethernet card, or similar device.

IP—Internet Protocol

IP Address—a set of four numbers (each between 0 and 255, with some restrictions), punctuated by periods, that uniquely identifies an address on a network. It is possible for a single computer to have multiple network interfaces; and for a single interface to have multiple IP addresses, but these are rarities. It is usually safe to assume that a single IP address corresponds to a single computer.

ISP—Internet Service Provider. A particular kind of ESP.

LEC—Local Exchange Carrier

Name Server—a machine on the network that looks up the host name and returns an IP address. This process of getting an IP address for a hostname is called name resolution. Usually, a given hostname will always generate the same IP address. Often, however, a given IP address can be generated by multiple hostnames. For example, the hostnames "www.mit.edu" and "anxiety-closet.mit.edu" will resolve to the same IP address, and hence, the same machine.

Network Interface—an entity inside a computer that sends and receives information over a communication link. Each network interface usually has a single internet protocol (IP) address associated with it.

PPP—Point-to-Point Protocol. Software that lets user turn a dial-up telephone connection into a point-to-point Internet connection. Usually used to run browsers over a phone line.

Server—A program, running on a networked computer, that responds to requests from client programs running on other networked computers.

TCP—Transmission Control Protocol. TCP/IP is the basic communication protocol that is the foundation of the Internet.

URL—Universal Resource Locator:

Web Page—is defined by its universal resource locator (URL). Most URLs (such as http, ftp and gopher) contain a hostname. Generally, a "web site" is a set of pages that are meaningfully linked together. Some people would prefer to define any URL as a web site, though "web page" is probably a better term for this.

Web Site—all documents with URLs beginning with a unique hostname. That is, http://www.mit.edu/people/mkgray/ and http://www.mit.edu/madlibs are part of the same web site, but a document http://web.mit.edu/ is a separate site.

Sources: SRI; Matthew Gray of the Massachusetts Institute of Technology

APPENDIX 2: DEFINING QUALITY OF SERVICE

Regarding Quality of Service (QoS). For the most part, users care about:

- The time it takes to download: latency/ping time is generally perceived as more important than bandwidth in this regard.
- Reliability. Factors include:
  - physical path redundancy
  - forward error correction
  - bandwidth reservation
  - provisioning "headroom",
  - probability of successfully getting a response (e.g., dialtone/PPP)

The issue of QoS is very complex. A number of people have tried to make lists of all the factors, but such lists are always incomplete. What is called for—according to the SwitchWare[18] advocates and to the Java Packets or "Jackets" developers—is a real-time way to negotiate communications costs/communications performance parameters by means of programmable switches/routers. User needs are dynamic, as are the capabilities enabled by technological innovation. Advocates say this will let the service suppliers (e.g., the telcos) evolve service configurations rapidly—at the speed of software development, not at the much slower speed of IETF/W3C standards processes. Even the users themselves may be able to program switches/routers, to define the characteristics of QoS according to their desires.

Critics of this position argue that there will be unacceptable overhead and performance degradation from negotiating QoS dynamically in real-time. Critics also point out that it is difficult to impose any one architecture, plan, or bureaucratic solution on the Internet; that most users need to "just ship the bits"; and finally, that the excessively "stately" nature of RAM-rich switches/routers will not scale in number of hosts served nor in performance, compared to simple "dumb" IP routing.

There are many gray areas between transport control protocol (TCP)-style reliability and UDP-style best-effort. Obviously, one such area would be UDP plus forward error correction (FEC). A less-explored area might be guaranteeing that "99% of the packets you receive are 100% error-free with a maximum jitter of 100 ms", letting 1% (or .1%, or 5%) of the packets be late and/or damaged. Such a guarantee could be a cost-effective approach for voice-over-Internet or audio-on-demand. Ultimately, users may end up being charged flat fee for unlimited TCP and UDP use, while paying per-megabit or per-minute for higher QoS features, including resource reservation, guaranteed delivery, and delivery insurance.

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[18] http://www.cis.upenn.edu/~switchware/

APPENDIX 3: THE VALS ™ CONSUMER SEGMENTATION SYSTEM

SRI International's proprietary Values and Lifestyles (VALS ™) consumer segmentation system focuses on consumers' motivations for buying products, the media they use, and the activities they engage in. On the basis of consumers' fundamental attitude and lifestyle orientations, VALS divides the adult U.S. population into eight psychographic segments of roughly similar size.

- *Actualizers* exhibit self-confidence and optimism. They share wide intellectual interests, engage in varied leisure activities, are well-informed, and lead active social lives. They are change leaders and are highly receptive to new products and technologies.
- *Fulfilleds* are usually mature and reflective. Their leisure and consumption activities center on the home. They gravitate strongly toward education and information, often reading widely and watching educational programming.
- *Believers* are strongly traditional and respect rules and authority. They prefer a settled, predictable lifestyle, socializing within the family and established groups. Fundamentally conservative, they are slow to change and technology averse.
- *Achievers* opt for a moderate, goal-oriented lifestyle. They center their lives on career and family. They prefer premium products. They avoid situations that introduce a high degree of change and stimulation.
- *Strivers* are often dissatisfied and unsure in their day-to-day lives. They have little discretionary income and tend toward narrow interests and social isolation. However, they are image conscious within their immediate peer group.
- *Experiencers* appreciate the unconventional. They are active and extroverted, and they like stimulation by the new, offbeat, and risky. Their lifestyle focuses on fashion, exercise, socializing and sports.
- *Makers* value practicality and self-sufficiency. They prefer hands-on, constructive activities and spend leisure time with family and close friends—rarely joining organizations. Preferring value to luxuries, they buy basic products.
- *Strugglers'* lives are narrowly focused by their lack of educational and financial resources. They feel powerless and are risk averse. Conservative and traditional, they are concerned about their security. Brand loyal, they use coupons and watch for sales.

SRI conducted its *LeadingEdge* survey of media consumers in some 1600 U.S. households during June 1996.

- Household selection was based on random-digit dialing in "prefixes" with an average household income of $15,000 or greater and a telephone screen to recruit an adult in each household to fill out a 24-page questionnaire on residential media use.
- This questionnaire included questions that let us apply SRI's VALS 2 psychographic analysis to the *LeadingEdge* data.
- To enrich coverage of online-service and Internet consumers, the sample included a 350-household oversample of modem users.
- The sample also included a 115-household oversample of male respondents to balance the tendency of survey research to over-represent female respondents.
- SRI weighted the survey data to mirror U.S. national demographic characteristics.
- To avoid inflating our market estimates, we assumed all missing responses—in which respondents left survey questions unanswered—to be negative responses.

Because people within each segment approach consumption in a similar way, the VALS segmentation system greatly enhances simple demographic analysis and helps companies effectively target product-design and marketing efforts.

Appendix B Cable Modem Market Study

Cable Modem Market Study:
Adoption Patterns and Impact on Internet Usage

Summary of Findings

by
Anne M. Hoag, Ph.D.

February, 1998

Cable Modem Market Study:
Adoption Patterns and Impact on Internet Usage

Executive Summary

- Study provides the first valid and statistically reliable results to answer the questions
  - Who adopts cable modems?
  - How does a cable modem affect how the Internet and other media are used in households?
  - What is the impact of a cable modem on a user's satisfaction with the Internet?

- Research design included both electronic focus group of cable modem users and large random sample survey (n=256) of both cable modem users and Internet users with slower dial-up modem access. Data gathered in a small U. S. market where cable modems had been available for three years, longer than almost anywhere else.

- Results indicate
  - The demographic profile of the cable modem adopter is dominated by occupation. Having an information-related job swamps other demographic and behavioral/ attitudinal factors.
  - Cable modem users spend more time on-line and spend more for Internet service.
  - Compared to households where Internet access is slow (2400 to 33,600 bps), cable modem household users (4 to 10 Mbps) watch less TV and talk on the phone less but consume slightly more print media, video games, PPV and home video.
  - Cable modem households use more "parts" of the Internet (email, Web, FTP, Usenet, IRCs/MUDs, tele- and video-conferencing).
  - Cable modem users perform more and a greater variety of tasks — work-related tasks, personal business, diversionary and social uses, and for acquiring goods and information.
  - Satisfaction with the Internet is a complex, multi-faceted concept.
  - Cable modem subscribers rate several facets of Internet satisfaction higher.
  - Cable modem users perceive the Internet to be more interactive and compatible but less complex than do their dial-up access counterparts.
  - Cable modem adoption is related to the prior adoption of a "cluster" of other cutting edge media and telecom products and services.

- These results are generalizable to a larger population with limits. The study's population and sample appear to have higher average education and income levels than the average U. S. household, though they probably differ little from average households with Internet. The market itself had 26% household Internet penetration, somewhat higher than in the average U.S. community.

Purpose of Study

The objective of this study is twofold: First, to determine the likely adoption patterns for cable modems in the context of a conventional market roll out and secondly, to estimate the likely impact of high speed access on satisfaction with and usage of the Internet and other media.

This formal study was undertaken because so little is known with regard to these questions. To date, only a handful of researchers have offered insights, and these are based on unscientific, though useful data (such as the focus group results of Deutsche Morgan Grenfell, 1997) . The cable companies who are currently marketing modems have reported favorable outcomes, but of course, these reports are for the consumption of investors and market analysts. Mostly, the problem is in the dearth of detail on adoption patterns, satisfaction and usage. This is the primary focus of the present study and the original research it was drawn from (Hoag, 1997).

Electronic Focus Group Results

Preliminary to the greater survey, 35 cable modem users were recruited to participate in an electronically mediated focus group. A Web site was established where participants could describe why they subscribed to the cable modem service, how it changed their use of and satisfaction with the Internet, and how their perceptions of the Internet changed after they got their cable modems. As with most focus groups, this was not a random sample, merely those individuals who responded to a letter sent to 120 residential cable modem subscribers in a single market.

In general, the feedback was very positive. Without exception, focus group respondents praised the service, declared the Internet vastly more useful, less frustrating and more flexible with a cable modem. Despite my expectation that users would express frustration with the cable company, almost no one offered such comments. There were three who complained the price was too high (between \$45 and \$70 per month, depending on speed) and another two or three cited reliability problems, but tempered their complaints with overall positive comments. Still others admitted to being pleasantly surprised by the value they got for their subscription fees.

Typical examples of the group's enthusiasm are the following comments, "I have been evangelizing the cable modem from day one"; "...worth its weight in gold"; "Everyone I tell about my Internet access through cable is incredibly jealous"; "I give the modem a 10."

To the open-ended question of why they had adopted a cable modem, almost all simply said for the speed. A few also offered that it was cheaper than ISDN or their current ISP, that they did it to free up their phone line, to obtain a fixed IP address or — most interestingly — that they got it to show off to friends, clients or co-workers.

Some typical responses were "[I got a cable modem because] I am a power hungry user"; "I read an article comparing T-1, ISDN and cable modems, so I got a cable modem"; "two of my friends had them and told me how fast they were. Now we play games together"; "My son was spending inordinate amount of time on AOL [so I got a cable modem]"; "have done some telecommuting since 1982 and couldn't pass up ethernet at home"; "I do it just to act cool."

As to how the cable modem changed their Internet usage, 100% claimed that it had a profound effect on usage. The common view was that data-intense applications, such as FTP, Web and videoconferencing, were feasible with a cable modem but not with a dial-up modem. The consensus was they spent more time on line and/or had started to use the Internet for new applications and to accomplish tasks previously handled by other means. Several reported that they went from only using email to adding FTP and the Web to their Internet repertoire. One declared he now streamed live video between his home and workplace (as a security camera system) and a few others said they now routinely videoconferenced. Another participant reported that since getting his cable modem, he no longer kept huge data files on his hard drive but stored them on a remote mainframe and, using his cable modem, called up the files as if the distance from the mainframe to his home was no greater than the distance from his hard drive to RAM. Another telecommuter said that his cable modem enabled him to abandon Federal Express to route Syquest and Jaz disks to clients.

Some interesting comments were, "being able to access files on your system at home from work is great"; "A 10 MB download is really scary with a 28.8 modem but no problemo with a cable modem—no downsides yet"; "Because of my dedicated connection I have actually done some more in the area of setting up my own FTP site"; "Receive, like, 100 MB Adobe files"; "I spend more time surfing now because it doesn't take the pages so darn long to come up"; "Now my system is on the Net 24 hrs. a day"; "Netscape is now a close friend. Backup on diskette? No way. Just connect to another computer an send copies of the files via ftp"; "I was able to give up second phone line."

Many responses implied that their home usage of cable modems was work-related but most also mentioned entertainment and personal research-related uses. Other comments implied that because of the cable modem, home Internet use changed from entertainment-only to a balance of personal and work/telecommuting applications.

In sum, every single focus group participant was very happy with their cable modems, some near to the point of rapture.

Model of Influence and Large Sample Survey Results

Following the focus group, a telephone survey of a random sample of 256 cable modem users and dial-up access Internet users was conducted. The response rate was very high, 78%, and all respondents shared the same cable provider in the same market allowing for comparison of the two groups.

Based on previous theoretical and empirical research and the findings of the focus group, a model was constructed to explain modem adoption and Internet and other media use. This model was devised to guide the development of the survey. The figure below summarizes the variables and their supposed influence.

In the left hand column, perceptions about how complex, compatible and interactive the Internet is are supposed to be related to choice of access capacity. Likewise, other factors are thought to be related to adoption: a "technology cluster" (A group of related media and IT previously adopted[30], this factor is intended to capture the status-conferring or show-off quality that some focus group participants valued), synchronous uses (such as IRCs, MUDs, tele- and video-conferencing), asynchronous uses (email, Web, FTP, Usenet), and demographic characteristics.

Figure 1
Model of Factors Related to Internet Access Capacity

Factors Affecting Demand	**Speed (Access Capacity)**	**Outcomes**
Perceived Internet Attributes *-Complexity* *-Compatibility* *-Interactiveness*	Cable Modem or Dial-Up Telephone Modem	Satisfaction with Internet
Technology Cluster		Consumption —of Internet —of other media
Synchronous & Asynchronous Communication Uses		
Demographic Characteristics *Income* *Age* *Occupation* *Gender*		

30 People were asked what media and IT they had at home. A trend emerged; common to a significant number of cable modem households was the prior adoption of all of the following: cellular phone, 2nd phone line, caller ID, call forwarding, digital camera, camcorder, big screen TV, pager, and three computer peripherals: a color printer, scanner and Zip/Jaz drive. These comprise the "technology cluster."

In the middle of the model, the choice of access capacity is represented by either a cable modem or a dial up modem. On the right, outcomes such as satisfaction and consumption levels of both the Internet and other media were measured to test correlation with high speed access. A total of 18 different facets of satisfaction were included with the idea that consumer satisfaction is a complex concept.

Likewise, consumption was measured in a variety of ways: First, in the obvious ways (how much time and money spent on the Internet, newspapers, magazines, television, on the phone, and so on), then too the frequency and intensity of Internet use related to various tasks: work (both for personal time management and doing business with others), diversion (entertainment), socializing, acquisition of things (shopping), and acquisition of information (research, downloading software).

The survey was designed to capture data on these various factors. For most variables, scales were constructed by combining several related survey items into a valid and statistically reliable measure. For example, "complexity" was created from five different survey questions which asked how complicated the Internet was to use. Another scale, "Diversion Uses" (under the category of "consumption") was constructed from six survey questions asking whether people use the Internet for playing games, having fun, etc.

The survey asked people whether and how much they used several different "parts" of the Internet. There are "parts" that permit synchronous communication: IRCs, MUDs, Internet telephony and videoconferencing. And there are "parts" that permit asynchronous communication: email, the Web, FTP, and the Usenet. Further, some "parts" often involve data-intense communication which high speed access noticeably improves (Web and video-conferencing for example). Email and text-based Usenet are believed to be un-improved by speed. In model testing, four separate measures were used: Intensity of FTP use, of Web use, of IRC/MUD use and of telephony/videoconferencing use.

The telephone survey was conducted in November, 1996. Data were subsequently analyzed using SPSS 7.0 for Windows (SPSS, 1995). A number of statistically significant relationships were discovered. Results are summarized in the following tables, with discussion following each table.

Factors Affecting Demand and Adoption

Conventional marketing wisdom implies that adopters of new information technologies are more likely to be male and have higher incomes and education. An initial glance at the demographics of the sample (**Table 1**), compared to 1990 Census data for the community in the study, seem to bear this out. More males and those with higher education levels had adopted home Internet access compared to the local population, and especially, males and those with much higher incomes dominate the cable modem adopter sample. It should be noted that overall, the population studied here has above average measures for all categories, compared to the general U. S. population. Still, the profile is similar to Internet users in general (see Nielsen, 1997). As a point of interest, the Internet had a 27% penetration of *homes* in the study population which is probably higher than the U.S. average where many people have Internet access at work or school but not at home.

Table 1
Comparison of Samples and General Local Population

	Population***	Cable Modem	Dial-up Modem
Mean Age	29.4	35.1	33.7
Males as% of Pop.	48%	79%	54%
Average HH Income	$33,331	$47,000	$33,000
Average Highest Education Attained[31]	3.49*	4.03**	3.95**

*Approximately half way between "some college" and "bachelor's degree"
**"Bachelor's degree"
***from 1990 Census

Still, these apparent adoption patterns are deceiving. Indeed, the test of the full model (**Table 2** below) reveals it is not being male that predicts cable modem adoption, to a much more significant degree, it is occupation. More specifically, it is related to information-related occupations, those jobs where either information is created (some but not all government workers, artists, work-at-home parents, writers, printers) marketed (some but not all sales professionals and marketing executives) or studied (some but not all students, researchers and scientists). Survey respondents described their occupations which were later classified by an expert so that within a job category, such as sales, salespeople who deal in non-information goods were separated from those who did.

In addition to the demographic factors, the other left hand side (LHS) variables were all fed together into a logistic regression to test the relationships between the various predictors of adoption and access capacity. The goal of logistic regression is to predict group membership for individual cases. Like multiple regression, it uses a linear equation with the predicted score of a case on the LHS and a constant and a series of coefficients multiplied by observations on the RHS (Tabachnick & Fidell, 1996). Logistic regression also estimates the odds of being in one group or another. Using this technique, we can how correlated independent variables demonstrate their effects in conjunction with and independent of others.

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31 The survey was coded as follows: 1=some high school; 2=high school diploma or GED; 3=some college; 4=bachelor's degree; 5=masters or professional degree; 6=doctorate degree

Results of the tests are presented in **Table 2** including chi-square tests, classification results, regression coefficients, Wald statistics, partial correlations and odds ratios. A test of the full model with all four categories of independent variables (13 variables) against a constant-only model was statistically reliable, Chi Square (13, n = 256) = 130.92, p. <.001, indicating that the predictors, as a set, were able to distinguish well between high-speed cable modem Internet users and those with slower dial-up modems. The model successfully classified 82% of all cases, an impressive result.

According to the Wald criterion, four independent variables of the 13 were significant in predicting outcome: an information-related occupation (W = 3.12, p < .05), intensity of FTP use (W = 12.47, p < .001) and intensity of Web use, (W = 13.11, p < .001). Household income was marginally significant (W = 3.12, p < .08).

Table 2
Summary of Logistic Regression Results

Chi-Square	df	Significance
130.92	13	.0000

Classification Table for Cable Modem

	Predicted .00	Predicted 1.00	% Correct
Observed .00	111	24	82.22%
Observed 1.00	22	99	81.82%
		Overall	82.03%

Variable	B	S.E.	Wald	df	Sig	R	Exp(B) "Odds Ratios"
FTP	.32	.09	12.47	1	.0004	.17	1.38
WWW .39	.11	13.11	1	.0003	.18	1.48	
IRC/MUD	-.06	.12	.27	1	.61	.00	.94
Tel/Vid	-.07	.14	.21	1	.65	.00	.90
Age	.01	.02	.09	1	.76	.00	1.01
Education	-.15	.21	.57	1	.45	.00	.86
Income.18	.10	3.11	1	.08	.06	1.19	
Info Job	.99	.46	4.73	1	.03	.09	2.69
Sex	.05	.41	.02	1	.90	.00	1.05
Compatibility	.08	.11	.56	1	.45	.00	1.08
Complexity	-.03	.07	.21	1	.65	.00	.97
Interactiveness	.08	.06	2.09	1	.15	.00	1.08

TC	.05	.09	.31	1	.58	.00	1.05
Constant	-7.43	2.91	6.54	1	.01		

The synchronous forms of Internet communication were not significant predictors of speed and were only weakly correlated with speed — this facet of the model is not supported. This implies that videoconferencing is not related to cable modem adoption (However, it seems this outcome is a result of there being too few videoconference users in the sample, and the tests cannot measure the effect accurately.). However, the strongest predictors of speed were the asynchronous data-intensive Internet uses, FTP and the Web. This was the case both in terms of their large Wald statistics which were also highly significant, the odds ratios, mentioned below, and in terms of their large and significant correlation coefficients.

Odds ratios show that cable modem subscribers were 170% more likely to have an information-related occupation and in terms of their Internet usage patterns, 38% more likely to be FTP-use intense and 48% more likely to be Web-use intense. They were only 19% more likely to have higher incomes. In conclusion, these statistics show that these three or four variables are the only reliable predictors of modem speed for the full model.

To reveal the relative importance of the predictors which were non-significant in the full model, smaller versions of the model were run as well. Results of these procedures, not presented here, indicate that no other combination of variables better explains the variance in the consumers' access capacity decision. When the most powerful predictors were removed (such as occupation), gender (male) does become mildly related to cable modem adoption. The technology cluster was a significant positive predictor of cable modem adoption as well.. And the nature of the cluster, that the adoption of these innovations may have a status-conferring quality, goes with the several comments of focus group participants. No matter how the model was reduced, age and education were never factors.

In summary, a number of factors are likely to lead to an Internet user's adoption of a cable modem but his or her occupation, any job (no matter the level) in an information field, is the strongest predictor. The second most influential factor is the data-intensiveness of Internet use. If you just email, you wouldn't get a cable modem. But if you need bandwidth for the Web or videoconferencing, you would be more likely to have one. The relationship among likelihood of getting a cable modem, Internet perceptions, demographic factors, how the user uses the Internet and what other technologies he/she already has adopted is very revealing. It suggests that old, established patterns are shifting — no longer is age, being male or having a high income and education indicative of Internet use. That so many cable modem subscribers also owned a near arsenal of cutting edge technologies is suggestive of an "early adopter" mentality. Though the study market was specifically chosen because it was the most "mature" cable modem market anywhere, and therefore presumably should have passed through the "early adopter" phase, the product is still apparently very young in terms of its life cycle.

Satisfaction and Consumption Factors

The balance of the model described in Figure 1 can be adequately tested using chi square cross tabular analysis of frequencies and t-tests. Satisfaction levels for 18 satisfaction measures are given in Table 3. Cable modem users were more satisfied on 15 of the 18 measured facets of satisfaction (12 of them at statistically reliable levels) though the mean differences between the two groups is not very great. Still and all, since a five point scale was used to measure all satisfaction items except "overall satisfaction" (which used 10 points), the difference between an average score of 4.25 and 3.92 (as in the case of the Web) may be very meaningful.

In only one area, cost of service, were the dial-up users more satisfied, hardly a surprise since typically, they spend less than half of what the cable modem users spend. However, at higher speeds, users are more satisfied with asynchronous uses of the Internet (email, Web and FTP) ($p < .01$ or $.05$, shown in Table 4).

For several other measures of satisfaction, cable modem users were more satisfied with the Internet. High-speed access subscribers were more satisfied with the Internet as a general way to communicate, to learn new things, to be more efficient, to get information, to shop and to work from home. They were more satisfied with on-line speed and customer service as well. Slow-modem users were more satisfied with the Internet as a way to socialize and with cost of service. Results for several items were inconclusive: satisfaction with Usenet, IRC/MUD, as a way to be entertained and reliability were not statistically reliable.

In general, it seems clear that cable modem users are more satisfied with the Internet than those with a slow dial-up modem. The mean differences in satisfaction are not very great but the narrow measurement scale could mask meaningful differences. Therefore, it is fairly safe to say that speed is related to satisfaction with the Internet.

Table 3

Satisfaction with the Internet: Sample Means

Group Statistics

	Cable Modem	N	Mean	Std Deviation
Satisfaction with E-Mail	no	131	4.34	0.63
	yes	118	4.50	0.70
with World Wide Web	no	90	3.92	0.82
	yes	120	4.25	0.71
with Usenet	no	24	3.79	0.72
	yes	75	3.69	1.00
with IRC/MUD	no	27	3.37	1.00
	yes	27	3.63	0.93
with FTP	no	55	3.78	0.98
	yes	99	4.14	0.83
..as a way to	no	135	4.07	0.87
communicate in general	yes	121	4.28	0.69
..as a way to	no	135	3.40	0.95
socialize	yes	121	3.17	0.78
..as a way to	no	135	3.64	0.88
be entertained	yes	121	3.71	0.77
..as a way to	no	135	4.07	0.73
learn new things	yes	121	4.38	0.60
..as a way to	no	135	3.79	0.93
be more efficient	yes	121	4.21	0.62
to get information	no	135	4.21	0.74
	yes	121	4.50	0.58
..as a way to shop	no	135	3.02	0.70
	yes	121	3.24	0.71
..as a way to	no	135	3.67	0.80
work from home	yes	121	4.15	0.81
Satisfaction with	no	135	3.10	1.18
on-line speed	yes	121	4.05	1.05
with reliability	no	135	3.54	0.90
	yes	121	3.71	0.89
with cost of service	no	135	4.01	0.94
	yes	121	3.44	0.97
with customer service	no	134	3.19	0.94
	yes	121	3.58	0.99
Overall Satisfaction	no	134	6.75	2.10
with Internet	yes	121	7.10	2.31